SOURCES OF PRODUCTIVITY CHANGES OF COMMERCIAL BANKS IN DEVELOPING ECONOMY: EVIDENCE FROM MALAYSIA, 1998-2003

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Abstract

Applying a non-parametric Malmquist Productivity Index (MPI) method, this paper attempts to investigate the productivity changes of Malaysian banks during the post crisis period of 1998-2003. Our results suggest that: (1) Malaysian banking sector have exhibit productivity regress of 6.3% and that the productivity regressed during the period of study was largely attributed to Technological (6.1%) rather than Technical Efficiency (0.2%) regress. (2) Malaysian banks regardless of size have exhibit productivity regress ranging from 1.5% to as high as 10.0% and (3) The smallest bank in our sample is too small to reap the benefits of economies of scale, while the largest bank in our sample, is too large to be scale efficient.

JEL Classification: G21; D24

Keywords: Finance and Banking, Productivity Change, Malmquist Productivity Index

1. Introduction

In Malaysia, as in other developing economies, the banking system plays an important role in the economy by channeling funds from those who have excess funds to those who have productive needs for those funds. Unlike in other developed nations, where the financial markets, as well as the banking system, work in unison to channel those funds, in developing countries, however, financial markets are undersized and sometimes completely absent. It falls on the banks to bridge the gap between savers and borrowers and to perform all tasks associated with the profitable and secure channeling of funds. Since the end of the 1980s, full scale and far reaching financial liberalization has been promoted in Malaysia to create a competitive market environment, thereby improving the managerial efficiency of banks. It was expected that a competitive market environment would provide financial institutions with the

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incentive to minimize management costs based on technically optimal choices. On the other hand, sound management of financial institutions is equally as important as efficient management of financial systems is to support economic development. Examples in industrialized countries have shown that while a financial liberalization policy improves managerial efficiency, without prudent regulations and supervision it will adversely affect the managerial robustness of financial institutions.

Despite the importance of the Malaysian banking sector to the economy, there is only a handful of microeconomic research performed on this area. The most notable was by Katib and Mathews (2000), Okuda and Hashimoto (2004) and Sufian (2004), which investigate Malaysian banks efficiency during the 1989-1995, 1991-1997 and 1998-2003 periods respectively. Krishnasamy *et al.* (2004), investigates Malaysian banks productivity changes during the post-merger period of 2000-2001.Compared to the earlier papers this paper has the following merits. First, Katib and Mathews (2000), Okuda and Hashimoto (2004) and Sufian (2004), have not examined the sources of productivity changes among Malaysian banks. Secondly, this paper also attempts to provide an extension to the paper by Krishnasamy *et al.* (2004), by considering a longer time-period and providing the most recent evidence on Malaysian banks productivity changes. By applying the non-parametric Malmquist Productivity Index (MPI) methodology, we attempt to investigate the sources of productive efficiency changes of the Malaysian banking sector during the post crisis period of 1998-2003. The paper is also aimed to fill a demanding gap in the literature on efficiency and productivity of Malaysian commercial banks as well as to provide the most recent evidence on the productivity changes of Malaysian commercial banks. Our results also suggest that during the period of study, Malaysian banks have exhibit slight improvement in SE particularly during the early years. However, during the later part, Malaysian banks have exhibit SE regress which could be resulted from the mega-merger program initiated by the Malaysian government and was concluded in the year 2001. During the period of study, our results suggest that all Malaysian banks regardless of size have exhibit productivity regress ranging from 1.5% to as high as 10.0%. Our results also suggest that, almost all large Malaysian

banks have reported Technical Efficiency regress. The decomposition of Technical Efficiency into its PTE and SE components suggest that while the smallest bank in our sample is too small to reap the benefits of economies of scale, the largest bank in our sample, is too large to be scale efficient. Overall our results suggest that the mid-sized banks has been able to adopt management practices that compensates for size while on the hand the smaller banks are trying to catch up with the best practices. This paper is set out as follows: The next section will provide a brief overview of the Malaysian banking sector. Section 3 reviews the main literature. Section 4 outlines the approaches to the measurement and estimation of productive efficiency change. Section 5 discusses the results and Section 6 concludes.

2. Brief Overview of the Malaysian Banking Industry

The Malaysian banking system has historically been characterized by its large number of small institutions. The Asian financial crisis of 1997 has not only caused serious damage to the Malaysian banking sector but also has exposed the vulnerabilities of the small banking institutions to exogenous shocks. Although the Malaysian central bank, Bank Negara Malaysia (BNM) has always encouraged banks to merge in order to achieve economies of scale and higher level of efficiency, only a few mergers among the banking institutions have taken place. The urgency to consolidate the banking sector was apparent during the Asian financial crisis that struck the region in 1997-1998, which has exposed the vulnerabilities of the small banking institutions and the need for these institutions to maintain a high level of capital. Furthermore, given the fact that much of the required financing in Malaysia was intermediated through the banking system, the risk associated with cyclical downturn in the economy would be much concentrated in the banking system.

In order to minimize the potential impact of systemic risks on the banking sector as a whole, following the deepening of the financial crisis, the Government took stronger measures to promote (force) merging of banking institutions. Subsequently, ten banking groups were formed. The ten banking groups or anchor banks are: Malayan Banking Berhad, RHB Bank Berhad, Public Bank Berhad, Bumiputra-Commerce Bank Berhad, Multi-Purpose Bank Berhad,

Hong Leong Bank Berhad, Affin Bank Berhad, Arab-Malaysian Bank Berhad, Southern Bank Berhad and EON Bank Berhad. Each bank had minimum shareholders' funds of Ringgit Malaysia (RM) 2 billion and asset base of at least RM 25 billion.

Table 1: **Malaysian Ten Commercial Banks**

Bank	**Abbreviation Used**
Affin Bank Bhd.	AFB
Alliance Bank Bhd.	ALB
AmBank Bhd.	AMB
Bumiputra-Commerce Bank Bhd.	BCB
EON Bank Bhd.	EON
Hong Leong Bank Bhd.	HLB
Maybank Bhd.	MBB
Public Bank Bhd.	PBB
RHB Bank Bhd.	RHB
Southern Bank Bhd.	SBB

3. Related Studies

Over the last decade, there has been considerable amount of research performed to study the productivity changes in the commercial banking industry aimed at informing regulators and practitioners faced with a changing environment in the banking industry (Casu *et al.*, 2004). During the 1980s and early 1990s, liberalization of the banking sector and increasing number of bank failures has also contributed to increased academic interest in the topic. However, earlier studies have mainly concentrated on the developed countries banking industry, and a few Pacific Basin countries banking sector in the latter part of the decade. Berg *et al.* (1992) was among the first to investigate productivity change in the banking industry. Using a sample of 346 banks in Norway over 1980-1989, they found that productivity declined at the average bank prior to the period of experiencing deregulation but grew rapidly when deregulation took place. Griffel-Tatje and Lovell (1997) investigated the sources of productivity change in Spanish banking over the period 1986-1993 using a generalized Malmquist productivity index and found that commercial banks had a lower rate of productivity growth compared to savings banks, but a higher rate

of potential productivity growth. Berg *et al.* (1993) expanded the study by Berg *et al.* (1992) to include Finnish and Swedish banking industries in their studies. They employed the Malmquist approach and used data from a single year in making cross-country comparisons. Among the earlier research to study productivity change in U.S. banking industry was by Wheelock and Wilson (1999). They applied the Malmquist approach to examine U.S. banks productivity from 1984-1993 and found that although banks on the frontier improved, productivity declined on average during this period attributed to the efficiency declines. Adopting a similar approach as Wheelock and Wilson (1999), Alam (2001) investigate productivity growth of U.S. commercial banks during the period of 1980s. They suggest significant productivity increase between 1983 and 1984, followed by a decline in the year 1985 and growth thereafter and suggest that productivity growth was mainly resulted from a shift in the frontier rather than from change in efficiency.

Despite substantial studies performed on the developed economies banking industry in regard to the efficiency and productivity of financial institutions, there are only a handful of studies performed on the Malaysian banking industry partly due to the lack of available data sources and the small sample of banks. As pointed by Kwan (2003), the reason for the lack of research on the efficiency of Asian banks is due to the lack of publicly available data for non-publicly traded Asian financial institutions. The most notable research conducted on Malaysian banks was by Katib and Mathews (2000), which studied the characteristics of the management structure and technical efficiency of the banking industry in Malaysia by DEA from 1989 to 1995. Okuda and Hashimoto (2004) conducted a research on the production technology of Malaysian domestic commercial banks with Stochastic Cost Functions approach adjusted to non-performing loans from the year 1991 to 1997. More recently, Sufian (2004) investigates the impact of the recent merger on the technical and scale efficiency of domestic incorporated Malaysian commercial banks. He found that Malaysian banks have exhibits an average overall efficiency level of 95.9% during the period of study and that the inefficiency was largely attributed to scale rather than pure technical. He concludes that the merger was successful particularly for the small and medium sized banks, which have

benefited from expansion via economies of scale. Krishnasamy *et al.* (2004) investigated Malaysian banks post-merger productivity changes. Applying two inputs, namely labour and total assets and loans and advances and total deposits as outputs, they found that during the period of 2000-2001, post-merger Malaysian banks has achieved a total factor productivity growth of 5.1%. They found that during the period, eight banks posted positive total productivity growth ranging from 1.3% to 19.7%, one bank exhibit total factor productivity regress of 13.3% and a bank was stagnant. The merger has not resulted in better scale efficiency of Malaysian banks as all banks exhibits scale efficiency regress with exception of two banks. The results also suggest rapid technological change of post-merger Malaysian banks ranging from 5.0% to 16.8%. Two banks however experienced technological regress during the period of study.

4. Methodology

Three different indices are frequently used to evaluate technological changes: the Fischer (1922), Tornqvist (1936), and Malmquist (1953) indexes. According to Grifell-Tatje and Lovell (1996), the Malmquist index has three main advantages relative to the Fischer and Tornqvist indices. Firstly, it does not require the profit maximization, or the cost minimization, assumption. Secondly, it does not require information on the input and output prices. Finally, if the researcher has panel data, it allows the decomposition of productivity changes into two components (technical efficiency change or catching up, and technical change or changes in the best practice). Its main disadvantage is the necessity to compute the distance functions. However, the Data Envelopment Analysis (DEA) technique can be used to solve this problem.

Malmquist productivity index is defined using distance functions. Suppose the function that describes the technology of production is given as: $F(X,Y) = 0$, where $X = (x_1, x_2,\ldots,x_t)$ is the input vector and $Y = (y_1, y_2,\ldots,y_s)$ is the output vector. Caves *et al.* (1982) provided an alternative interpretation of production technology using the concept of 'distance function'. They defined the output distance function as $D(X,Y) = min_{\mu}[_{\mu}: F (X\ ^{Y}/_{\mu}) = 0)]$ where μ_y is the minimum equi-proportional change in the output vector. The output distance function measures the maximum proportional change in output

required to place (X,Y) on the efficiency frontier. If the evaluated production unit is efficient, $D(X,Y) = 1$ otherwise, $D(X,Y) < 1$. Distance function may also be computed with input orientation, reference technology in a certain time period and CRS or VRS specification. Caves *et al.* (1982) defines the output based Malmquist productivity index to compare performance of a production unit in time period t and t+1 with reference to period t technology as

$$M_t(y^{t+1}, x^{t+1}, y^t, x^t) = \frac{D^t(y^{t+1}, x^{t+1})}{D^t(y^t, x^t)} \quad (1)$$

Alternatively, we may define output based Malmquist productivity index with reference to period t+1 technology as

$$M_{t+1}(y^{t+1}, x^{t+1}, y^t, x^t) = \frac{D^{t+1}(y^{t+1}, x^{t+1})}{D^{t+1}(y^t, x^t)} \quad (2)$$

$M>1$ means that period (t+1) productivity is greater than period t productivity, whilst $M<1$ means productivity decline and $M=1$ corresponds to stagnation.

Fare *et al.* (1994) defines an index that incorporates Malmquist indices in both periods. This they suggest to avoid choice of the time-period arbitrarily. Fare *et al.* (1994) specifies the output based Malmquist productivity change index as. This is the geometric mean of output based Malmquist productivity indices with reference to period t and period t+1 technology.

$$M(y^{t+1}, x^{t+1}, y^t, x^t) = \left[\frac{D^{t+1}(y_{t+1}, x_{t+1})}{D^t(y^{t+1}, x^{t+1})} \times \frac{D^{t+1}(y^t, x^t)}{D^t(y^t, x^t)} \right]^{1/2} =$$

$$\frac{D^t(y^t, x^t)}{D^{t+1}(y^{t+1}, x^{t+1})} \times \left[\frac{D^{t+1}(y_{t+1}, x_{t+1})}{D^t(y^{t+1}, x^{t+1})} \times \frac{D^{t+1}(y^t, x^t)}{D^t(y^t, x^t)} \right]^{1/2} \quad (3)$$

where $\left[\frac{D^{t+1}(y_{t+1}, x_{t+1})}{D^t(y^t, x^t)} \right]$ is the change in relative technical efficiency between periods t and t+1 and

$\left[\frac{D(y_{t+1}, x_{t+1})}{D^{t+1}(y^{t+1}, x^{t+1})} \times \frac{D^1(y^t, x^t)}{D^{t+1}(y^t, x^t)} \right]^{1/2}$ captures the shift in technology (technological change) between the two time periods evaluated as (X_t, Y_t) and (X_t+1, Y_t+1). For each production unit, the calculation

and decomposition of the adjacent period version of the Malmquist index includes five different functions,

Total Factor Productivity Change Index	$\frac{D^t(y^t,x^t)}{D^{t+1}(y^{t+1},x^{t+1})}\times\left[\frac{D^{t+1}(y_{t+1},x_{t+1})}{D^t(y^{t+1},x^{t+1})}\times\frac{D^{t+1}(y^t,x^t)}{D^t(y^t,x^t)}\right]^{1/2}$	(4)
Technological Change Index	$\left[\frac{D^{t+1}(y_{t+1},x_{t+1})}{D^t(y^{t+1},x^{t+1})}\times\frac{D^{t+1}(y^t,x^t)}{D^t(y^t,x^t)}\right]^{1/2}$	(5)
Technical Efficiency Change Index	$\left[\frac{D^{t+1}(CRS)(y_{t+1},x_{t+1})}{D^t(CRS)(y^t,x^t)}\right]$	(6)
Pure Technical Efficiency Change Index	$\left[\frac{D^{t+1}(VRS)(y_{t+1},x_{t+1})}{D^t(VRS)(y^t,x^t)}\right]$	(7)
Scale Efficiency Change Index	$\left[\frac{D^{t+1}(CRS)(y_{t+1},x_{t+1})}{D^t(CRS)(y^t,x^t)}\right]/\left[\frac{D^{t+1}(VRS)(y_{t+1},x_{t+1})}{D^t(VRS)(y^t,x^t)}\right]$	(8)

5. Data and Results

For the empirical analysis, *all* domestic incorporated Malaysian commercial banks from 1998 to 2003 as summarize in table 1 would be used. As in Casu and Girardone (2004), the sample comprises only continuously operating institutions, to avoid the impact of entry and exit and concentrate on the behavior of Malaysian banks during the period of study. During the study period, banks that were acquired or failed are dropped from the sample so that the final sample contains only surviving banks as of 2003. So as to focus on commercial banks and to maintain homogeneity, only commercial banks that make commercial loans and accept deposits from the public are included in the analysis. Therefore, Malaysian Islamic Banks, Development Banks, Investment Banks, Export Import Banks and Cooperative Banks are excluded from the sample. Annual data were taken from published balance sheet information in annual reports of each individual bank. Variable definition is one of the most difficult tasks in banking studies. There is consensus concerning the fact that banking firm is a multi-product organization. However, there is also some disagreement on what banks produce and how to measure bank production. The final decision depends on

the underlying concept of a bank, the problem at stake and the availability of information. The approach of input and output definition used in this study is a variation of the intermediation approach, which was originally developed by Sealey and Lindley (1977). The intermediation approach posits total loans and interest income as outputs, whereas deposits along with physical capital are defined as inputs. According to Berger and Humphrey (1997), the intermediation approach might be more suitable for studying efficiency of the entire financial institutions. Furthermore, Sathye (2001) also noted that this approach is more relevant to financial institutions as it is inclusive of interest expenses, which often accounts for one-half to two-thirds of total costs depending on the phase of the interest rate cycles. Following Isik and Hassan (2003) and Sathye (2001) among others, the intermediation approach or asset approach to define bank inputs and outputs would be adopted. Accordingly, two inputs and two outputs would be used consisting of:

Outputs: *y1* = Total Loans; *y2* = Interest Income.
Inputs: *x1* = Fixed assets; *x2* = Total deposits

The summary of data used is presented in Table 2 below. In this section we discuss productivity change as measured by the Malmquist total factor productivity index and assign the change in total factor productivity to technical and/or technical change. We also attempt to attribute any change in technical efficiency to change in pure technical efficiency and/or scale efficiency change. The summary of annual means of Total Factor Productivity Change (Malmquist), Technological Change (TC), Technical Efficiency Change (TE), and its decomposition into Pure Technical Efficiency Change (PTE) and Scale Efficiency Change (SE) for the year 1998-2003 is presented in Table 3 below. All indices are relative to the previous year and hence the output begins with the year 1999. As depicted in Table 3 below, the Malmquist results suggest that during the period of 1998-2003, Malaysian banking sector have exhibit productivity regress of 6.3%. With the exception for the year 2001, our results suggest that Malaysian banks have reported productivity decline in 1999 (14.4%), 2000 (7.8%), 2001 (5.8%) and 4.7% (2002). It is clear from Table 3 that the productivity regressed during

the period of study was largely attributed to TC regress (6.1%) rather than TE (0.2%).

Table 2: **Mean, Minimum Maximum and Standard Deviation: Inputs and Outputs**

		1998 (RMb)	1999 (RMb)	2000 (RMb)	2001 (RMb)	2002 (RMb)	2003 (RMb)
Outputs							
Total Loans	Min	5,150	6,326	7,204	7,878	7,213	7,227
	Mean	16,828	19,796	24,072	28,435	30,003	33,330
	Max	56,277	57,489	79,177	92,654	95,453	102,488
	S.D	15,373	16,729	21,872	25,281	69,339	28,864
Interest Income	Min	855.4	1,448	1,606	1,363	615.8	1,026
	Mean	4,375	5,484	6,629	7,003	7,838	8,406
	Max	12,549	15,110	19,463	22,576	25,277	25,907
	S.D	3,951	4,890	5,896	6,579	7,378	7,567
Inputs							
Fixed Assets	Min	39.9	34.0	26.1	22.4	36.1	33.5
	Mean	254.4	338.5	396.3	448.5	441.7	457.4
	Max	836.2	826.5	1,142	1,418	1,376	1,420
	S.D	279.4	300.3	361.2	432.8	422.1	435.7
Total Deposits	Min	5,507	7,414	9,125	9,161	7,966	9,023
	Mean	20,855	26,593	31,977	35,075	37,172	39,735
	Max	67,249	69,004	101,957	115,573	116,647	123,065
	S.D	18,726	21,392	28,486	31,740	32,157	33,936

From Table 3 it is also apparent that Malaysian banks have exhibit TC regress during all years except for the year 2001 while on the other hand TE has resulted to productivity regressed from the year 2001. The decomposition of TE into its PTE and SE components depicts clear findings. It is clear from Table 3 that PTE has largely resulted to Malaysian banks TE regress. During the period of study, our results suggest that Malaysian banks have exhibit PTE regress especially during the latter part of the period. It could be argued that the intensification of competition among the domestic banking sector has resulted to the low PTE of Malaysian banks during the later part of our studies. Our results also suggest that during the period of study, Malaysian banks have exhibit slight improvement in SE which is clear from Table 3 was during the early years. However, during the later part, it is apparent from Table 3 that Malaysian banks have exhibit SE regress which could be resulted from the mega-merger

program initiated by the Malaysian government and was concluded in the year 2001. It could be argued that during the later part of study, Malaysian banks have to absorb extra capacities, burdened with the task of closing duplicated branches and have to incur higher costs for systems integration and employee lay off arising from the merger.

Table 3: **Malmquist Index Summary of Annual Means**

Bank	**Technical Efficiency Change (CU)**	**Technological Change (TC)**	**CU Decomposition**		**Total Factor Productivity Change (Malmquist)**
			Pure Technical Efficiency Change	**Scale Efficiency Change**	
1998-1999	1.011	0.847	0.989	1.023	0.856
1999-2000	1.043	0.883	1.027	1.016	0.922
2000-2001	0.990	1.031	1.003	0.987	1.020
2001-2002	0.986	0.955	0.987	0.999	0.942
2002-2003	0.962	0.991	0.978	0.984	0.953
Geometric Mean	0.998	0.939	0.997	1.002	0.937

We now turn to discuss Malaysian banks specific behavior during the period of study. From Table 4, it is clear that during the period of study all Malaysian banks regardless of size have exhibit productivity regress ranging from 1.5% (SBB) to as high as 10.0% (MBB).

Table 4: **Malmquist Index Summary of Bank Means**

Bank	**Technical Efficiency Change (CU)**	**Technological Change (TC)**	**CU Decomposition**		**Total Factor Productivity Change (Malmquist)**
			Pure Technical Efficiency Change	**Scale Efficiency Change**	
AFB	0.971	0.984	0.971	1.000	0.956
ALB	0.984	0.931	1.000	0.984	0.916
AMB	1.011	0.918	1.017	0.994	0.928
BCB	0.997	0.953	0.985	1.013	0.950
EON	1.014	0.942	1.008	1.006	0.955
HLB	1.015	0.903	0.999	1.016	0.955
MBB	0.990	0.909	1.000	0.990	0.900
PBB	1.019	0.888	1.011	1.008	0.905
RHB	0.981	0.982	0.977	1.004	0.964
SBB	1.000	0.985	1.000	1.000	0.985
Geometric Mean	0.998	0.939	0.997	1.002	0.937

Our results also suggest that while all Malaysian banks were found to have reported TC regress, four banks were found to have exhibit TE progress, a bank was stagnant and five banks were found to have exhibit TE regress during the period. Interestingly, our results suggest that, all large Malaysian banks have reported TE regress, with the exception of PBB, which reported TE progress of 1.9%. The decomposition of TE into its PTE and SE components depicts interesting findings. Our results suggest that while AMB, which is the smallest bank in our sample is too small to reap the benefits of economies of scale, on the other hand MBB the largest bank in our sample, is too large to be scale efficient. Overall our results suggest that the mid-sized banks has been able to adopt management practices that compensates for size while on the hand the smaller banks are trying to catch up with the best practices. In contrast to the results by Krishnamsamy *et al.* (2004), which suggest that PTE has largely contributed to Malaysian banks Technical Efficiency progress, our results suggest that scale efficiency has greater positive impact to Malaysian banks TE especially during the early part of the studies.

6. Conclusions

Applying a non-parametric Malmquist Productivity Index (MPI) method, this paper attempts to investigate the productivity changes of Malaysian banks during the post crisis period of 1998-2003. Our results suggest that during the period of 1998-2003, Malaysian banking sector have exhibit productivity regress of 6.3% and that the productivity regressed during the period of study was largely attributed to Technological Change (TC) regress (6.1%) rather than Technical Efficiency (TE) (0.2%). The decomposition of Technical Efficiency into its Pure Technical Efficiency (PTE) and Scale Efficiency (SE) suggest that PTE has largely resulted to Malaysian banks Technical Efficiency regress during the period of study. Our results suggest that Malaysian banks have exhibit PTE regress especially during the latter part of the period, which could be argued to have caused by the intensification of competition among the domestic banking sector during the later part of our studies. Our results also suggest that during the period of study, Malaysian banks have exhibit slight improvement in SE particularly during the early

years. However, during the later part, Malaysian banks have exhibit SE regress which could be resulted from the mega-merger program initiated by the Malaysian government and was concluded in the year 2001. During the period of study, our results suggest that all Malaysian banks regardless of size have exhibit productivity regress ranging from 1.5% to as high as 10.0%. Our results also suggest that, almost all large Malaysian banks have reported Technical Efficiency regress. The decomposition of Technical Efficiency into its PTE and SE components suggest that while the smallest bank in our sample is too small to reap the benefits of economies of scale, the largest bank in our sample, is too large to be scale efficient. Overall our results suggest that the mid-sized banks has been able to adopt management practices that compensates for size while on the hand the smaller banks are trying to catch up with the best practices.

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